

Preparation of Cold model test stand with function check of the electronics

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1. Introduction

Cavity geometry and resonant modes are often studied with computer codes. In the case of the RFQ, a fully 3D simulation package like Mafia has been used to characterize the mode structure. Unfortunately, the accuracy of any 3D code is insufficient to give final indications about the cavity performances. A full-size model of the SNS RFQ was built to perform field measurements and finalize the dimensions of the RFQ geometry.

The necessary field measurements are implemented by using the bead perturbation method, where an object (bead) is pulled inside the cavity, inducing a frequency perturbation that is proportional to the square of the E or H field amplitude. To support such measurements, a bead-pull apparatus has been prepared to do systematic measurements and data acquisition.

2. System Description

The system is described in Fig. 1. An HP8510 network analyzer is used to perform the RF measurements. The commercial software Igor, running on a Macintosh computer, controls all motors and, via GPIB, the network analyzer. Both the setup and the software have been adapted and modified from the existing structure that was used by the Beam Electrodynamics Group to develop and build the RF cavity for the PEP II B factory.

The bead's motion is controlled by four independent motors, one per quadrant. Each motor acts on a kevlar string that carries one dielectric and one metallic bead. The dielectric bead is pulled along the vanes, in the high E field area; the metallic bead is pulled in the high H field portion of each quadrant. A sample of a scan in one of the four quadrants is shown in Fig. 2 for E field measurements and Fig. 3 for H field measurements. The presence of the pi-mode stabilizing rods can be clearly seen in the H field plots, whereas the E field perturbation due to those rods is not noticeable in these measurements.

3. Data Acquisition

The field perturbation measurements are performed in two modes: frequency and phase. Frequency measurements record the frequency shift induced by the beads. The resonant frequency is taken by setting the bead at a given point inside the RFQ and finding the

peak of the frequency response. In this case, all frequency peaks are read by the instrument and plotted by the computer. Each scan takes several minutes.

A faster, but less precise measurement, is made by keeping the RF frequency constant and observing the phase deviations due to the bead perturbation. In this case the beads are constantly moving and the instrument records the phase vs. time plot. This scan can be done in the order of a few seconds.

A snapshot of the acquisition screens is shown in Fig. 4 and 5. Fig. 4 shows the main panel, from which it is possible to perform frequency scans or to call the phase scan panel, shown in Fig. 5.

All data acquired by the computer can be saved in simple text files for post-processing.

4. Status

The bead-pull apparatus is functional and is supporting the systematic data acquisition that is part of the cold model test program. Cut-off frequency, field flatness and mode structure (dipole and quadrupole) have already been characterized. Thanks to this setup all cavity dimensions have already been finalized.

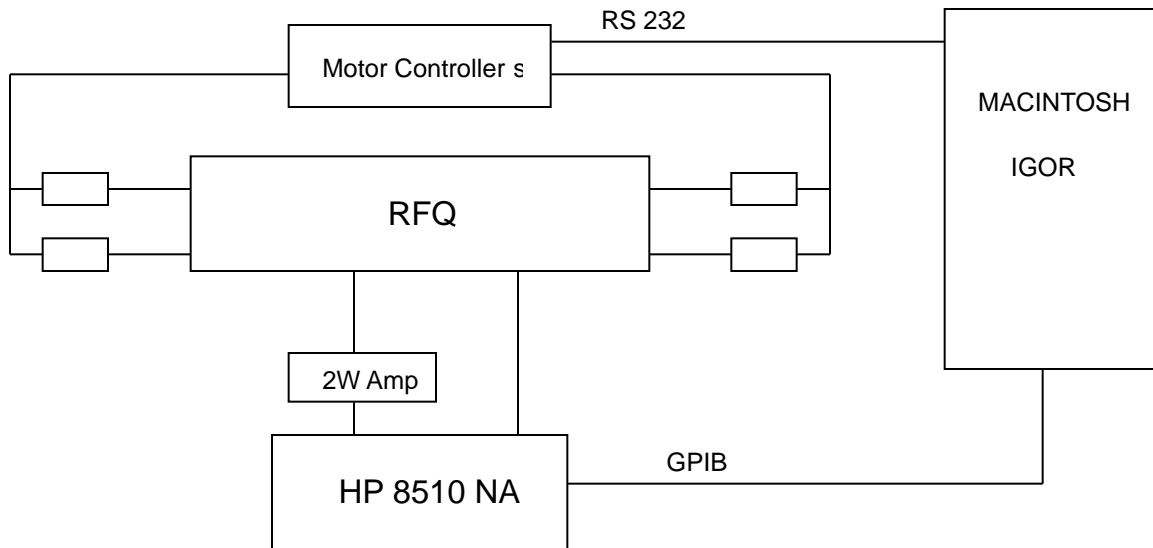


Figure 1

Figure2, Plot 2

../19jun/19junFEq1.6.awav.txt

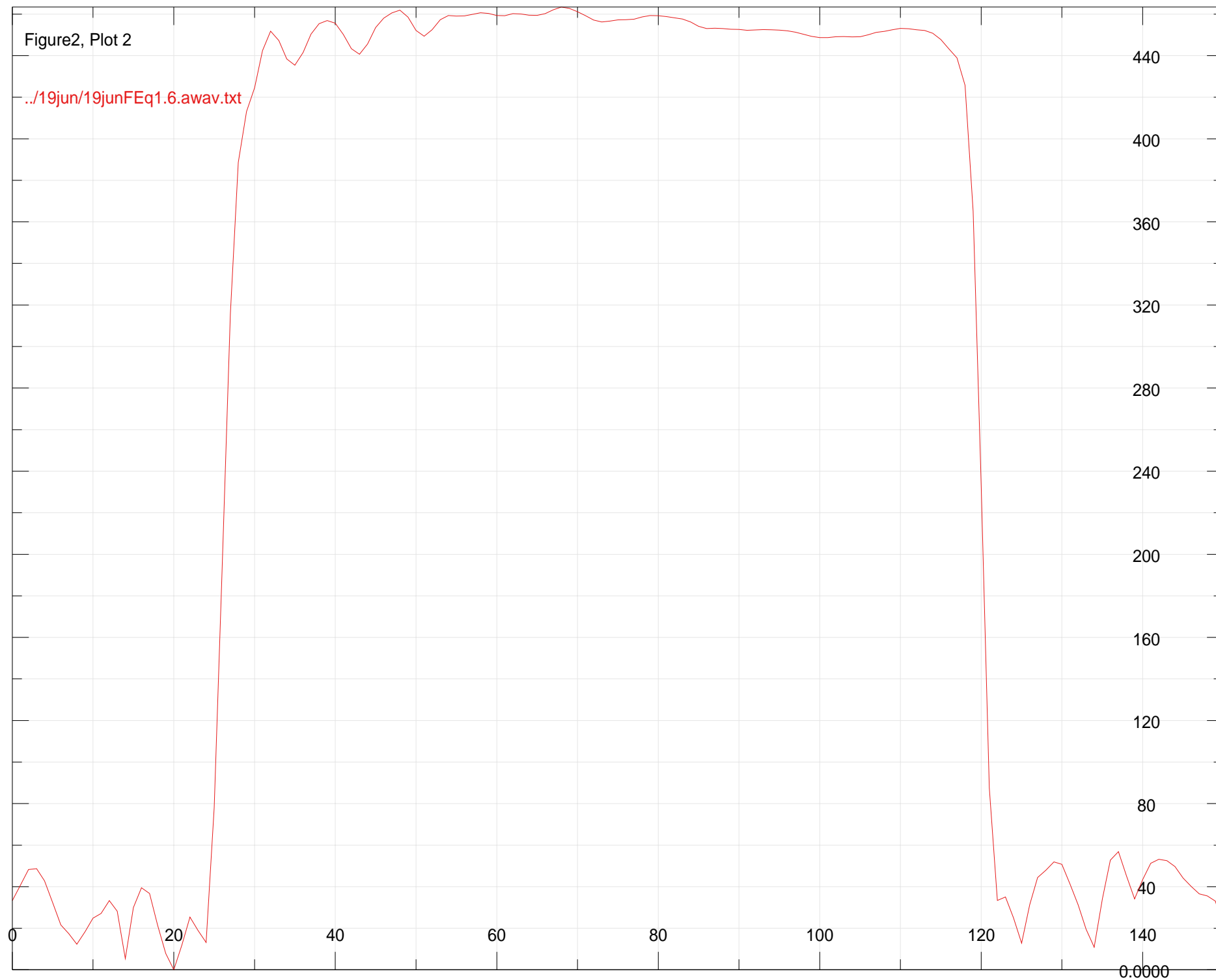
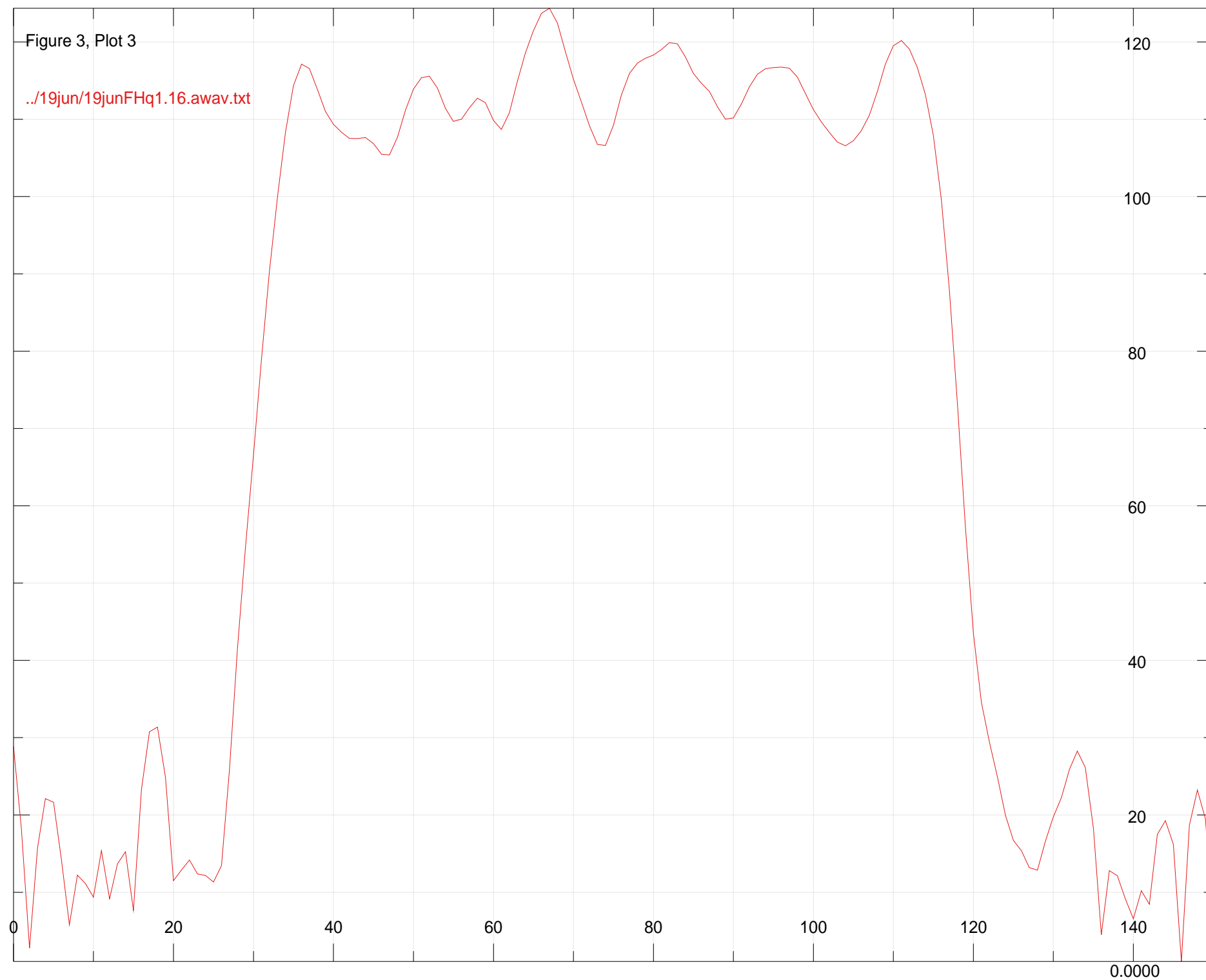


Figure 3, Plot 3

../19jun/19junFHq1.16.awav.txt



RFQ Cold Model: Bead Pull Control Windo

Step 1: Perfrom every start of exp. or rebooting of equipment.

Init. Motor...

Initialize GPIB

Measure Freq Now

Last CenterFreq Measured (MHz)
402.265

Step 2:

Measurement Type

Fast Phase Scan

☒ Freq Scan
☐ Do Not Use!
Or... Phase mode below is obsolete and not operational.
Use Fast Phase button to the left.

Step 3:

For Freq Scans

Wave naming is automatic.

Enter Date (mmdd) 29may

Run Number is appended to the end of the wave's name.

Next Run # 3

Reset

Freq Scan Parameters

For All Freq Scans

Step (cm) 1

For Single Freq Scan

Quads: 1=UR, 2=UL, 3=LL, 4=LR

Bead: 1=Inner, 2=Outer

Bead # 2

Quadrant # 1

Automated Wave Functions

Save Wave...

Load Wave...

Graph Waves...

Kill Waves...

Step 4:

Analyzer Setup & Q Value

For Freq Scan, enter approx center freq and the scan span below.

Freq (MHz) 402.257

Span (MHz) 1

Averaging Factor 0

Press to display on Analyzer.

Display It

Scan a Single Quadrant

Scan All Quads (E Field)

Scan All Quads (H Field)

Bead Position Display

Target	Actual	Refresh
I (cm): 150	-149.998	
II (cm): 0	-0.016438	
III (cm): 0	-0.0032876	
IV (cm): 0	0.0032876	
Angle (deg): 0	0	
Steps remaining: 0		
Speed: No screen update		

Move Bead To ...

Figure 4

5

RFQ Cold Model: Bead Pull Control Window

Step 1: Perform every start of exp. or rebooting of equipment.

Init. Motor...
Initialize GPIB

Measure Freq Now

Last CenterFreq Measured (MHz)
402.285

Step 2:

Measurement Type

Fast Phase Scan
Or... Phase mode below is obsolete and not recommended

☒ **Freq Scan**
☐ **Do Not Use!**

Use Fast Phase button to the left.

Step 3:

For Freq Scans
Wave scanning is automatic.

Enter Date (mmdd): 29msy

Run Number is appended to the end of the wave's name.

Next Run #: 5 Reset

Freq Scan Parameters

For All Freq Scans

Step (cm): 1

For Single Freq Scan

Quadr: 1=UR, 2=UL, 3=LL, 4=LR
Bead: 1=inner, 2=outer

Bead #: 2

Quadrant #: 1

Automated Wave Functions

Save Wave...
Load Wave...
Graph Waves...
Kill Waves...

Step 4:

Analyzer Setup & Q Value
For Freq Scan, enter approx center freq and

PhasePanel Close

Sweep Speed (s): 10
Degrees/div: 50

Approx. Center Frequency (MHz): 403.54

Enter Date (mmdd): 29msy

Next Run Number: 1 Reset Run Number

Run Number will be appended to end of WaveName.

Bead: 2 Bead: 1=inner (IF), 2=Outer (HF)

Quadrant #: 1 Quadr: 1=UR, 2=UL, 3=LL, 4=LR

Acquire a the Bead-In Center Freq. before first scan, before changing quadrants, and before scanning a new bead type.

Require Bead-In Center Freq.
Initiate Scan

III(cm): 0	-0.0032876
IV(cm): 0	0.0032876
Angle (deg): 0	0
Steps remaining: 0	
Speed: No screen update	

Move Bead To ...

Figure 5